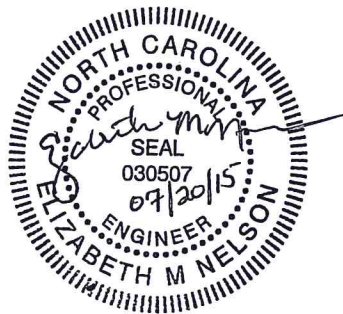


# Flood Study

For  
**SUNSET BEACH WEST**  
Sunset Beach, North Carolina

Prepared for  
**SUNSET BEACH WEST, LLC**

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## INTRODUCTION

Sunset Beach West is approximately 25 acre site located at the west end of Sunset Beach in Brunswick County. The site is located west of the existing end of West Main Street (SR 1177), approximately 0.57 miles west of the intersection of West Main Street and Sunset Boulevard (SR 1172). Figure 1 in Appendix A shows the Project Location. There is existing shoreline stabilization west of the end of West Main Street, and the remainder of the site is currently undeveloped. The site is bordered to the south by the Atlantic Ocean and to the north by Salt Boiler Creek. The adjacent east property is developed as single family residential, and the adjacent west property is the undeveloped North Carolina Coastal Reserve Bird Island. The existing elevation of the property ranges from 2 feet to 26 feet NAVD88 (North American Vertical Datum of 1988), with a rolling terrain of dune crests and troughs.

Sunset Beach West, LLC, is proposing a twenty-one (21) lot single family residential subdivision with amenities. Access to the subdivision is proposed by the installation of a wooden bridge that will be accessed from the end of West Main Street and will span Salt Boiler Creek and adjacent coastal wetlands. The bridge is proposed to be constructed on pilings, and will be 27 feet wide and approximately 620 feet long. The bridge decking will be constructed with adequate spacing to allow stormwater runoff to pass between the decking boards, and therefore will be considered a pervious surface. The proposed bridge will connect to a proposed 20-foot wide asphalt road to access the residential lots. Amenities proposed for the residential community include a wooden boardwalk with dune walkovers, walking trails, a gazebo, and a bird watching/ kayak fixed dock. These structures will be constructed using pilings, and no grading will occur within the coastal marsh or within the CAMA setback. Intended construction on the residential lots consists of residential structures erected on pilings.

The developer proposes to maintain the existing terrain to the maximum extent possible. However, due to the rolling terrain of the property, fill ranging from 1 foot to 8 feet is proposed to bring lots to finished grade and promote positive drainage.

## **BACKGROUND INFORMATION**

In order to predict flood levels throughout Brunswick County, Flood Insurance Studies are performed by FEMA in association with the North Carolina Floodplain Mapping Program. The studies generate Flood Insurance Rate Maps (FIRMs) based on existing topography, land cover, and the erosion expected during the 100 year flood event. The findings are detailed in Flood Insurance Study Reports.

Stillwater Elevations (SWELs) are determined from the Flood Insurance Studies. They are defined as projected flooding levels associated with a storm event. These elevations do not take into account the effects of wind generated wave action. Predicted stillwater elevations are determined for the 10, 50, 100, and 500 year storms.

Engineering analysis is necessary to account for higher flood levels associated with the effects of wind generated waves. FEMA provides the Coastal Hazard Analysis Modeling Program (CHAMP) for this purpose. CHAMP generates wave heights by combining a module that takes into account the effects of erosion with the Wave Height Analysis for Flood Insurance Studies (WHAFIS) computer model and the wave run-up analysis program (RUNUP). Stillwater Elevations are added to wave heights to give predicted Base Flood Elevations (BFEs), or total flood depths, which are reported on the FIRM. The floodplain on the FIRM is subsequently divided into zones based on hazard levels and Base Flood Elevation.

The project site is located on the barrier island of Sunset Beach, adjacent to the Atlantic Ocean. Due to this exposure, the property is subject to flooding as a result of wind



generated waves. The site is located on FIRM CID number 375359, panel number 1044 (Map Number 3720104400J) in a VE Zone with BFE at 17 feet, 18 feet and 20 feet (see Figure 2 in Appendix A). VE Zones are defined as areas along coasts subject to inundation by the 1-percent-annual-chance (100-year) flood event with additional hazards associated with storm-induced waves. VE Zones are characterized by wave heights greater than 3 feet.

A Coastal Flood Hazard Modeling and Mapping Study was performed by Dewberry and Davis, LLC, dated November 15, 2002, for the North Carolina Floodplain Mapping Program (NCFMP). A copy of the CHAMP model that was developed for the Town of Sunset Beach was obtained from NCFMP by Cape Fear Engineering, Inc.

## **STUDY PURPOSE**

The Code of Ordinances for the Town of Sunset Beach requires compliance with National Flood Insurance Program (NFIP) regulations related to obstructions and fill placed in V zones.

FEMA Technical Bulletin 5-93 (TB 5-93) on Free-Of-Obstruction Requirements for Buildings Located in Coastal High Hazard Areas addresses NFIP Section 60.3(e)(6) which states that a community shall “prohibit the use of fill for structural support of buildings within Zones V1-30, VE, and V...”.

According to the Floodplain Mapping Branch of the North Carolina Division of Emergency Management, FEMA Region IV has advised that placement of up to one foot of fill that is not supported by a retaining wall does not require an engineering analysis to satisfy the requirements of FEMA TB 5-93. The subject site plan proposes placing 1 foot to 8 feet of fill on the project site to bring lot to finished grade and promote positive drainage.

Fill is allowed on coastal building sites for landscaping and site grading, as is proposed on the project site, "...as long as the fill does not interfere with the free passage of floodwaters and debris underneath the building or cause changes in flow direction during coastal storms such that floodwaters will cause additional damage to buildings on the site or to any adjacent buildings" per FEMA TB 5-93.

The existing elevations at the location of the proposed road vary from approximately 3 feet to 19 feet. The material will be redistributed for the construction of the roadway, with final elevations ranging from approximately 5 feet to 11 feet. The final grades proposed for each residential lot will vary based on the final design and location of each house. For the purpose of this analysis, it is assumed that there will be a constant grade from the proposed road to the 25' front yard setback, and that a maximum elevation of 12 feet will be established at the 25' front yard setback. Any existing elevation lower than 12 feet from the front setback line to the 60' CAMA setback will also be assumed to be filled to an elevation of 12 feet.

TB 5-93 addresses concrete pads poured below elevated coastal buildings. The bulletin outlines that concrete pads "...to be used for parking, as a floor in an enclosed storage area, or as the floor of an enclosed area used for access to the elevated lowest floor of a building, may be poured beneath an elevated coastal building." TB 5-93 also states that "The use of fill beneath an elevated building to elevate a slab above natural grade is considered an obstruction and is therefore prohibited." The Floodplain Mapping Branch of the North Carolina Division of Emergency Management recommends that all concrete slabs be constructed with minimal or no reinforcement, and be no more than 4" thick. Expansion joints should divide the pad into 3- to 4-foot square sections to minimize damage to other structures if the pad is damaged by a major flood event.

The Town has requested a study report that includes the results of a WHAFIS model showing the effect of the proposed fill on wave heights during the 1% annual chance

flood event, including the effects of erosion. The engineering study performed and detailed here addresses these matters specifically.

The results of the study demonstrate that the proposed fill will not increase the Base Flood Elevation. Furthermore, the construction of concrete pads or brick pavers for parking will not form an obstruction such that the floodwaters will cause additional damage to buildings on the site or any adjacent building.

## **PROCEDURES**

An analysis was performed by Cape Fear Engineering using the CHAMP software to determine the potential impacts of proposed fill at the site. The first model was completed based on the existing profile to determine the BFE for the pre-fill conditions. Next, a model was carried out using the existing profile with the addition of the proposed fill. The following data was collected to complete the engineering analysis in the CHAMP computer model.

### Transect

Coastal areas are modeled along transects, cross sections taken perpendicular to the mean shoreline, which are representative of the surrounding land features. As recommended by the Town, three transects were modeled. Each transect begins at elevation 0 feet and extends perpendicular to the shoreline, to the point of intersection with contour 14.1 feet. This value is the 100-year flood SWEL plus wave setup. See Figure 3 in Appendix A for the transect locations.

### Stillwater Elevations

The associated Stillwater Elevations (SWEL) for Sunset Beach were adopted from the effective Flood Insurance Study Report for Brunswick County dated June 2, 2006. See Table 1 below.



Table 1: Stillwater Elevation

Event Frequency	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
SWEL, ft (NAVD 88)	6.3	10.0	11.6	14.8

### Topography

The existing topographic information along each transects is a composite of contours generated from Light Detection and Ranging (LiDAR) data downloaded from the NCFMP, and on-site survey data collected in June 2015 by East Coast Engineering and Surveying along each transect. The topographic datum is North American Vertical Datum of 1988 (NAVD88). See Figure 3 in Appendix A for a map of existing grades for the study area.

### Land Cover

Data on land cover, including buildings and vegetation was gathered based on aerial photographs along with additional information provided in the Dewberry & Davis Coastal Flood Hazard Modeling and Mapping Report obtained from FEMA.

### Erosion Assessment

Coastal sand dunes will likely erode during the 100-year storm and therefore cannot be relied upon as barriers to flooding. FEMA procedures were used to quantify erosion of the Primary Frontal Dune (PFD) located along the shoreline. The PFD was determined from a topographic profile of the transect. The frontal dune reservoir was determined to be less than 540 square feet, and by FEMA methodology, subject to dune removal. The analysis was performed in the Erosion module of the CHAMP software.

### Starting Wave Conditions

Starting wave conditions were adopted from the Dewberry & Davis Coastal Flood Hazard Modeling and Mapping Report obtained from FEMA. The 100-year significant wave height is 22.1 feet. The average significant wave peak period associated with a maximum wave height of 18.7 feet for the data is 17.1 seconds.

### Wave Setup

Wave setup was adopted from the effective Flood Insurance Study Report for Brunswick County dated June 2, 2006. For Sunset Beach, the wave setup is 2.5 feet and was calculated by the methodology outlined in Shore Protection Manual (U.S. Army Corps of Engineers, 1984).

### Wave Runup

Wave runup was not considered to be a factor in determining the BFE because the profile at Sunset Beach slopes gently and the SWEL plus wave setup is above the profile elevation.

## **RECOMMENDATIONS**

The WHAFIS computer model was successfully completed displaying no increase in Base Flood Elevation due to the proposed fill. Figure 4 in Appendix A show the WHAFIS output graphs for existing conditions and proposed fill. The figures show that the Base Flood Elevation for the project site does not change after the addition of the proposed fill.

As stated earlier, FEMA regulations prohibit the use of fill for structural support of buildings within Zones V1-30, VE, and V. All planned construction at the project site will be built on pilings that will be supported below grade. Therefore, the fill should be allowed because it will not be supporting the buildings and by definition is not structural.



Fill is allowed on coastal building sites for landscaping and stormwater drainage. Based on the review of the results of the CHAMP models, it is the opinion of Cape Fear Engineering, Inc. that the fill should not be considered an obstruction because it will not raise the Base Flood Elevations, and consequently should not interfere with the free passage of floodwaters and debris during coastal storms, and the floodwaters should not cause additional damage to buildings on the site or any adjacent buildings.

It is proposed that every lot at the project site be filled as necessary for drainage or landscaping to an elevation no higher than 12 feet. We recommend that proposed finished grade be considered “natural grade”. Per FEMA Technical Bulletin 5-93, concrete pads placed at grade below buildings for parking purposes are allowed. Cape Fear Engineering, Inc. recommends that the concrete pads be allowed provided that the top of the slab is not placed above the finished grade elevations proposed by this study. The concrete pads should be a maximum depth of 4” and constructed with expansion joints every 3 to 4 feet. Brick pavers should also be allowed below buildings for parking purposes.